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The Use of Technology for Sexually Transmitted Disease Partner Services in the United States: A Structured Review

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Abstract

Background: Since the late 1990s, health departments and sexually transmitted disease (STD) programs throughout the United States have used technologies, such as the Internet and mobile phones, to provide services to persons with a sexually transmitted infection, including human immunodeficiency virus (HIV), and their sex partners, also known as partner services. This study reviewed the published literature to assess and compare partner services outcomes as a result of using technology and to calculate cost savings through cases averted.

Methods: We conducted a structured literature review of all US studies that examined the use of technology to notify persons exposed to an STD (syphilis, chlamydia, gonorrhea), including HIV, by health care professionals in the United States from 2000 to 2017. Outcome measures, including the number of partners notified, screened or tested; and new positives identified, were captured and cost savings were calculated, when data were available.

Results: Seven studies were identified. Methods used for partner services differed across studies, although email was the primary mode in 6 (83%) of the 7 studies. Only 2 of the 7 studies compared use of technology for partner services to traditional partner services. Between 10% and 97% of partners were successfully notified of their exposure through the use of technology and between 34% and 81% were screened or tested. Five studies reported on new infections identified, which ranged from 3 to 19. Use of technology for partner services saved programs between US \$22,795 and US \$45,362 in direct and indirect medical costs.

Conclusions: Use of technology for partner services increased the number of partners notified, screened or tested, and new infections found. Importantly, the use of technology allowed programs to reach partners who otherwise would not have been notified of their exposure to an STD or HIV. Improved response times and time to treatment were also seen as was re-engagement into care for previous HIV positive patients. Data and outcome measures across the studies were not standardized, making it difficult to generalize conclusions. Although not a replacement for traditional partner services, the use of technology enhances partner service outcomes.

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Partner services, and specifically partner notification, whereby partners of patients with a diagnosed sexually transmitted disease (STD) or human immunodeficiency virus (HIV) infection are informed of their exposure, has long been a staple in public health efforts to control STD and HIV transmission.¹ According to the Centers for Disease Control and Prevention (CDC), the goal of partner services is to maximize the number of partners who are notified of their exposure to an STD or HIV, treated, and linked to services.² Notification can be undertaken in 3 ways—by the patient themselves, known as self- or patient-referral; by a health department staff member, often referred to as a disease intervention specialist (DIS), known as provider referral; or via third-party referral, where a professional other than health department staff member carries out the notification. Disease intervention specialist–led, partner notification investigations include interviewing patients who have tested positive for an STD, typically syphilis or HIV, eliciting sex partners within a prescribed time frame, locating and notifying those partners of their potential exposure, and referring those partners for STD screening, treatment, and care. Disease intervention specialists also link patients and partners to other services, such as HIV care, alcohol and drug programs, and mental health services.

For decades, DIS-led partner notification efforts involved notifying partners of their exposure by mailing letters or locating them “in the field” at their homes, places of work, or other venues.³ However, with the advent of the Internet, and later mobile phones, DIS began using technology-driven strategies to locate and notify partners.^{3–5} With the rising popularity of the Internet in the late 1990s, STD patients increasingly reported meeting sex partners online in chat rooms and later on websites specifically designed to facilitate sexual encounters. As the use of technology-based social venues increased, many patients could not provide traditional locating information about their partners, such as a real name, physical address, or telephone number. Rather, profile names and, in some cases, email addresses were often the only information known. To reach partners online, DIS began sending messages via email or joining websites to provide partner services through the venue’s internal messaging platforms. This became known as Internet-based partner services. Over time, the Internet became a recognized information source, allowing DIS to find traditional locating information of partners. Internet access also provided other invaluable pieces of information about partners, such as work affiliations, pictures, and social contacts that could be used to verify that the correct person was being reached. More recently, social networking sites and mobile applications have become popular venues for meeting sex partners.^{3,6–8}

The purpose of this review was to assess and compare the outcomes of studies that examined the use of technology for STD and HIV partner services in the United States. Specifically, we sought to determine if the use of email, texting, social or sexual networking sites, or mobile phones increased the number of partners notified, screened, or tested; and new positives identified. Where applicable, we calculated the potential direct medical costs and indirect costs saved by technology-based partner service activities using the CDC’s Sexually Transmitted Infection Costs (STIC) calculator, a tool designed to help estimate the economic benefits of STD prevention programs such as partner services.⁹

METHODS

Our search included peer-reviewed studies that examined the use of technology to notify persons exposed to an STD (syphilis, chlamydia, gonorrhea), including HIV, by public health professionals in the United States from 2000 to August 31, 2017. We excluded studies that were conducted prior to 2000, outside the United States, not published in English, or did not report outcome measures. Systematic reviews, dissertations, editorials/opinion pieces, or studies in the grey literature, such as conference proceedings, technical reports, and white papers, were also excluded.

Search terms (Fig. 1) were entered into the following databases: PubMed, MEDLINE, PsycINFO, ProQuest, Embase, Google Scholar, and Scopus. The search identified 185 articles. The articles were compiled in EndNote and an initial review of the title and abstracts was conducted by 2 researchers. After a full review of the 185 articles, 178 were excluded for failing to meet the inclusion criteria, resulting in a final data set of 7 articles. One hundred forty-five articles were not about technology-based partner services, 18 did not report outcome data, 8 were grey literature/commentary/editorial, and 7 were not conducted in the U.S. References from the final data set of 7 articles were reviewed for additional relevant studies. No additional articles were identified.

The STIC FIGURE (STIC) calculator allows programs to estimate the direct medical costs and indirect costs averted as a result of prevention program activities such as sequelae costs prevented due to treatment, prevention of congenital syphilis or STI-attributable HIV infections, or interruption of STI transmission within a population.⁸ To calculate direct medical costs and indirect costs saved, we reviewed the 7 identified articles for data variables required to generate an estimate, specifically the number of infections treated and the number of presumptive or preventive treatment instances. Three studies provided enough information to allow for a STIC calculation given the following assumptions—all partners were male, all syphilis cases were either primary or secondary, and where not reported, infected cases were treated.^{10–12} Timeframes for cost savings calculations were based on reported study dates and therefore vary by study.

RESULTS

Between 2000 and 2015, 7 studies^{3,10–15} reported outcome data (Table 1) on the use of technology for reaching partners including online chat rooms, email, social or sexual networking sites, mobile phone applications, and text messages. Due to the ever-changing communication landscape, the methods used for partner services differed across studies; however, there were overlaps. Only 2 of the 7 studies compared technology-based with traditional partner services.^{10,14} Below we report results by outcome measure (notification, screening and testing, and new positives) and by type of technology used (email, text, social/sexual websites, etc.)

NOTIFICATION

E-mail

E-mail was the type of technology used in 6 (83%) of the 7 studies.^{3,10–14} It should be noted that definitions of notification varied slightly across programs. For most studies, notification included a direct response from a contacted partner or presentation at a clinic. Two studies included the return of email read receipt messages.^{11,12} Udeagu et al¹⁴ defined notification as those partners who responded to DIS and who accepted information about an HIV exposure. In the earliest study, Klausner et al³ sent email messages to identified partners' screen names, informing them of their exposure. However, Klausner et al³ did not report the number of partners notified specifically through the use of a communication technology, nor did they provide data comparing outcomes of partner services as a result of technology vs traditional means. Similarly, 3 studies also did not compare the use of technology to traditional partner services, but they all provided data regarding successful email notifications.^{11–13} Accordingly, between 26% and 89% of partners were successfully notified of their exposure through e-mail notification across the 5 studies providing such data.^{10–14}

Vest et al¹⁰ and Udeagu et al¹⁴ were the only studies that compared technology-based partner services to traditional partner services. As mentioned earlier, their definitions of notification varied slightly. Vest et al¹⁰ defined notification as any elicited partner contacted by DIS staff, regardless of a response from the partner. They found that traditional partner services yielded a higher percentage of successful partner notifications than by email (69.7% vs 49.7%). Udeagu and colleagues,¹⁴ on the other hand, made clear distinctions in how they defined contact versus notification rates. The contact rate was defined as the proportion of partners from whom DIS received a response. The contact rate was inclusive of partners who refused notification—partners who did not want to know the purpose of the DIS email. Of the partners who were contacted and responsive to DIS, those who were then given information about their exposure to HIV were considered notified. That is, the notification rate consisted of the proportion of partners who responded to DIS and accepted HIV exposure information. Those notified included partners confirmed to be previously HIV diagnosed or who reported an unknown or HIV-negative serostatus. Udeagu et al¹⁴ found that the contact rate for traditional partner notification (69%) was higher in comparison to email notification (41%). However, the use of technology resulted in a higher likelihood of notifying partners of their exposure than traditional notification (odds ratio [OR], 2.1; 95% confidence interval [95% CI], 1.2–3.4).

Texting

Two studies assessed text messaging for partner notification.^{11,14} Hightow-Weidman et al¹¹ sent text messages to 29 identified partners who did not respond to traditional or email-based partner notification. Fourteen (48%) of the partners responded and were notified of their exposure. The study, however, did not compare outcomes between text messages, traditional, and email-based partner notification. Similarly, Udeagu and colleagues¹⁴ sent texts to 368 partners whose only viable contact information was a cellphone number. They compared partner notification outcomes by mode of contact and found that texting resulted in a higher

contact rate (77%) than traditional (69%) or technology-based methods (41%; $P < 0.0001$). However, no significant differences were found in notification rates between texting vs technology-based partner services, though both had a higher likelihood of notifying a contacted partner when compared to traditional partner services (OR, 2.4; 95% CI, 1.7–3.2 and OR, 2.1; 95% CI, 1.2–3.4; $P = 0.0001$ respectively). Both studies found that partners responded quickly to texts with a median response time of 57.5 minutes and 1 day, respectively.

Mobile Applications and Social Media Websites

Only 1 study, Pennise et al¹⁵ reported on the use of mobile applications (“apps”) and social media websites. The apps and social media websites were used to gather demographic and geographic information about the sexual partners named in 16 DIS interviews. Six (29%) partners were located using information gathered from apps and websites and 2 (10%) were notified of their exposure via an unnamed website. The authors noted that mobile apps were not used for notification.

SCREENING AND TESTING

Five (71%) of the 7 studies provided sufficient data on the number of partners screened or tested as a result of the use of technology.^{3,10,12–14} Of the 2 studies reporting on texting,^{11,14} only one provided information on screening/testing outcomes.¹⁴ Accordingly, the percentage of partners tested or screened due to technology use ranged from 34% to 80.7% across the 5 studies. Vest et al¹⁰ reported the highest percentage of technology-initiated testing and screening (80.7%) in their case-comparison study among HIV or syphilis-infected persons with pseudonymous e-mail sexual partners and unmatched controls. Yet, traditional partner notification generated an even higher percentage of partners tested and screened (95.4%; $P < 0.001$). Pioquinto et al¹³ also reported a high percentage of testing and screening (54%) as a result of technology use in their case study of a 31-year-old man infected with syphilis who reported 16 Internet sex partners.

In contrast, Ehlman et al¹² and Udeagu et al¹⁴ reported the lowest percentage of successful technology-initiated testing and screening among the 5 studies. Udeagu et al¹⁴ found that 34% ($n = 31$) of partners notified through email and 45% ($n = 105$) notified through text were tested for HIV compared to partners notified through traditional means (69%, $P < 0.0001$). Ehlman et al¹² found that 35% of email-notified partners presented for syphilis testing. Specifically, 53 (52%) partners who provided DIS with traditional contact information were screened for syphilis, whereas 48 (48%) partners who did not provide traditional contact information to DIS reported they were evaluated and treated if necessary.

NEW INFECTIONS

Five (71%) studies reported the number of new infections found through technology^{10,14,15} and as a result of texting, specifically, in 2 studies.^{11,14} Technology use resulted in identification of new infections ranging from 3 to 19 with Vest and colleagues¹⁰ reporting the highest number and percentage (26.8%) of new HIV and/or syphilis infections identified among 71 Internet partners tested. This was a slightly lower percentage, but not statistically

significant ($P=0.601$), when compared with traditional partner notification, which yielded 106 new infections or 29.9% of the 355 partners screened and tested.

The remaining studies reported lower numbers^{3,11,12,14,15} and percentages (7%–10%) of new HIV and/or syphilis infections among Internet-notified partners. Klausner et al³ identified 4 new cases of syphilis (20%) and 1 previous positive. Ehlman et al¹² found 7 (7%) new syphilis cases of the 101 partners evaluated. Hightow-Weidman et al¹¹ found 7 new HIV infections and 11 new syphilis infections among 230 email-notified partners. They texted 29 contacts who did not respond to traditional or email-based partner services and identified 1 (7%) new HIV infection and 2 (14%) new syphilis infections among the 14 partners who responded. Udeagu et al¹⁴ also found new infections among partners notified through email or text message. Three (10%) new HIV infections were discovered among 31 partners notified through email, and 5 (5%) new HIV infections were identified among 105 text-notified partners.

Finally, only 1 study, Pennise et al,¹⁵ reported new infections of gonorrhea and chlamydia in addition to new HIV and syphilis infections. The researchers identified 2 new HIV infections, 1 new HIV-gonorrhea coinfection, 1 syphilis-chlamydia coinfection, 1 new chlamydia infection, and 2 new gonorrhea infections, one of which was in a previously diagnosed HIV positive partner. Pennise et al¹⁵ did not specify which new infections were found as a result of the use of technology.

COST SAVINGS

Of the 3 studies for which we were able to estimate direct medical and indirect costs (Table 2), we found that technology-based partner service efforts saved programs between US \$22,795 and US \$45,362 (in 2016 dollars) due to interrupted transmission of syphilis and future cases averted.^{10–12}

DISCUSSION

Overall, we found the use of technology resulted in additional partners being notified, screened or tested, and identified as new positives. Importantly, DIS reached partners who otherwise would not have been notified of their STD/HIV exposure and, in some instances, reached HIV positive individuals who had fallen out of care.¹¹ We estimate that the use of technology for partner services saved programs between US \$22,795 and US \$45,362 in direct medical costs and indirect costs. Although notification alone does not guarantee that partners will seek screening and treatment, it does provide them with information from which they can make informed decisions about medical care and future partners.

Most studies encouraged the integration of technology into existing partner service programs, when possible. All concluded that technology offered worthwhile advantages including increased operational efficiency^{10,11,14}; improved outcomes in both traditional and technology-based partner service cases¹²; and rapid, efficient, and reliable means of finding and notifying partners.^{3,10–12,14} Though not identified as a benefit in the studies, technology helps to fulfill the ethical duty or privilege to warn. As outlined in the CDC's Recommendations for Partner Services Programs, health care providers, either directly or

with help from public health authorities, bear the responsibility of, at a minimum, doing their due diligence to let a person know of an exposure whenever possible.² In one study, researchers found that partners were appreciative of partner service messages and found them helpful and appropriate.³ Another study suggested that patient involvement in partner notification and use of instant messaging improved response rates.¹³

Texting offered unique advantages. Often, it was the only mode of communication that yielded a reply and had vastly quicker response times than traditional or email-based partner services.^{11,14} Data security and confidentiality concerns exist, however, as telecommunication providers are not required to protect the content of text messages,¹¹ prompting fear that messages could be turned over to external parties, such as the police.

The importance of DIS who are technologically savvy and abreast of the ever-changing privacy rules of social and sexual networking venues was also noted.^{11,12,14} Disease intervention specialist also benefited from real-time access to websites and mobile apps, which allowed index patients to access their social networking accounts to gather partner location information, verify screen names, and identify other social network contacts.¹⁵ Programs noted that resources, buy-in, and training are needed when integrating technology into a partner services program; however, once in place, use of technology did not result in additional field work or extended work hours. Instead, the reach and effectiveness of partner services was expanded.^{10,14} One study compared outcomes before and after centralizing technology-based activities with a single field coordinator. Centralization increased the number of partner's notified, screened, and new positives identified and treated.¹¹ It is unknown if other factors may have contributed to the success of centralization—for example, morbidity levels, coordinator skill and experience with communication technology, and comprehensive policies. More studies comparing centralization and decentralization of technology-based partner services could help answer these questions.

This review had limitations. First, a review of the grey literature was not conducted. It is possible technology-based partner service studies were highlighted in conference proceedings, technical reports, and white papers. Second, differences in program goals and objectives, data collection techniques, and variations in the definitions of contact and notification prevented us from comparing partner service efforts across studies and as such, we are unable to speak to the reasons for program successes and failures beyond noting that technology use resulted in additional partners notified, screened, and new infections identified. These variations occur for a variety of reasons which include: (1) functions of a program's data management system, which dictates what information is available to be evaluated; (2) a program's approaches to conducting PS, which can affect evaluation efforts; and (3) integral factors, such as the reputation of the health department, interviewing skills of DIS, and the (in)ability to collect identifying information from websites and apps. More research and evaluation of existing partner service programs would be useful. Future evaluations could compare partner service outcomes by mode of notification (eg, telephone vs email vs texting) when possible. These evaluations can elucidate which methods result in more notifications, new infections, faster response times, or quicker time to treatment. They could also provide useful information to programs about changes in communication use and preferences of patients and partners over time. Future studies could also compare outcome

measures before and after the implementation of technology to determine if new notification modes improve the number of partners notified, screened, and treated.

Finally, generalizability is limited given that most of the study participants were men, a large proportion of which were men who have sex with men. Thus, it is not clear if technology use would enhance partner services for other populations.

Although not a replacement for traditional PS, technology enhances partner service outcomes. We would like to be able to point to a specific program and declare it to be the most effective, unfortunately, given the limitations stated above, we are unable to do that. Rather, programs will need to determine their level of technology use for partner services—from accessing the Internet to search for traditional information to being able to log into sex seeking websites or apps to directly notify a partner—based on their program goals, infrastructure, epidemiology, and available resources. The CDC's Division of STD Prevention has supported the adaption and integration of technology into partner service activities and offers a toolkit to help health departments incorporate the use of technology into their efforts.^{16–18} Given the ubiquity and near total integration of technology into all aspects of American lives, at a minimum, the ability to gather information about partners from the Internet and other social networking venues seems essential for partner services.

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Partner notification, partner services, case management
AND
Sexually transmitted disease, STD, sexually transmitted infection, STI
AND
Internet, internet-based, online, email, smart phone, Technology, digital, app, applications,
mobile, phone, cell, cellular, text, SMS, short message service, geosocial networking, social
networking, online, phone app
AND
Outcome Evaluation, evaluation, outcomes

Figure 1.

List of search terms. Partner notification, partner services, case management AND Sexually transmitted disease, STD, sexually transmitted infection, STI AND Internet, Internet-based, online, email, smart phone, Technology, digital, app, applications, mobile, phone, cell, cellular, text, SMS, short message service, geosocial networking, social networking, online, phone app AND Outcome Evaluation, evaluation, outcomes.

TABLE 1. Study Descriptions and Reported Outcomes Related to Use of Technology for STD-related Partner Services

Author/Year of Publication	Study Location and Year of Data Collection	Population	Disease Type	Means of Contact Exposure or Intervention	No. Index Cases	No. Partners Notified	No. Partners Evaluated/Screened/Tested	No. New Infections
(1) Klausner et al., 2000 ³	San Francisco, June to August 1999	MSM syphilis cases	Syphilis	Online chat room	2	NR	20 [*]	4 [*]
(2) Proquinto et al., 2007 ¹³	Los Angeles, case in December 2002; case 2 in January 2005	MSM syphilis cases	Syphilis	Email messages	2	Case 1: 29 (26%) of 111 partners notified Case 2: 13 of 10 partners (81%)	Case 1: NR Case 2: 7 (64%) of 13	NR
(3) Vest et al., 2007 ¹⁰	Austin or Travis Co, TX; January 1, 2004 to June 30, 2006	Cases: 53 partners of HIV and/or syphilis index patients for whom only email addresses were known Controls: 265 partners of HIV and/or early syphilis index patients for whom traditional contact information was known	HIV or early syphilis	Cases: Email sent to partners Controls: Traditional contact (letter, face to face, telephone)	Cases: 53 Controls: 265 (traditional); 265	Cases: 88 (49.7%) of 177 Controls: 372 (69.7%) of 534	Cases: 71 (80.7%) of 88 Controls: 355 (95.4%) of 372	Cases: 19 (26.8%) Controls: 106 (29.9%)
(4) Ehلمان et al., 2008 ¹²	Washington, DC; January 2007 to June 2008	Patients with early syphilis infections (primary, secondary, and early latent)	Early syphilis	Emails to named partners	27	291 (76%) of 381	101 (35%) of 291	7 (7%)
(5) Hightow-Wiedman et al., 2014 ¹¹	State of North Carolina IPN data from July 1, 2011 to June 30, 2012; Traditional FN from January 1 to December 31, 2010 Evaluation of pilot TxIPN program, November 21, 2011 to June 30, 2012	Clients diagnosed with HIV or syphilis	HIV and syphilis	Emails, social or sexual networking sites, mobile phone text messages	Internet: 362 Text: 29	Internet: 230 (63.5%) of 362 Text: 14 [†] (48.3%) of 29	Internet: NR Text: NR	Internet: 7 HIV (3.0%) [‡] 11 (4.8%) [‡] syphilis Text: 2 (14%) syphilis 1 (7%) HIV
(6) Udeagwu et al., 2014 ¹⁴	New York City, NY January 2011 to October 2012	HIV-diagnosed patients and their named partners	HIV	Emails, messages sent to social and dating/hook-up websites, mobile phone text messages	Traditional PS: 2604 Internet: 275 Text: 368	Traditional: 1803 (69%) contacted 1770 (98%) notified Internet: 112 (41%) contacted 100 (89%) notified [§] Text: 285 (77%) contacted 276 (97%) notified [§]	Traditional: 805 (69%) Internet: 31 (34%) Text: 105 (45%)	Traditional: 106 (13%) Internet: 3 (10%) Text: 5 (5%)
(7) Pennise et al., 2015 ¹⁵	Monroe Co, Rochester, New York, February to May 2013.	Large case investigation stemming from a GC diagnosis in a previously known HIV-positive male.	HIV, gonorrhea, syphilis, chlamydia	Messages sent via unnamed website	Index cases: 14 2 (7 new infections; 7 Previously known HIV positive cases) Cluster cases: 2 (uninfected partners of index cases)	2	31 (32%)	7 new infections total: • 2 new HIV cases • 1 HIV/GC case • 1 syph/CT case

Author/Year of Publication	Study Location and Year of Data Collection	Population	Disease Type	Means of Contact Exposure or Intervention	No. Index Cases	No. Partners Notified	No. Partners Evaluated/Screened/Tested	No. New Infections
								2 GC or Ct cases 1 GC case in PKP

* Klausner et al. did not specifically note, of the partners screened/tested and new infections identified, which were a direct result of using technology-based partner services.

† Twenty nine contacts were texted of which 14 responded. Hightow-Weidman et al. do not indicate whether all 29 contacts were considered notified or only the 14 who responded.

‡ Percentages were calculated by authors of this review who assumed that all patients who presented for testing were tested for both HIV and syphilis.

§ Udeagu et al. defined contact rates as the number of partners reached by any means divided by the number of partners for whom contact was attempted.

¶ Udeagu et al. defined notification rates as the proportion of partners contacted who accepted HIV exposure notification.

// Pennise et al. did not indicate, of the partners screened/tested and new infections identified, which were a direct result of technology-based partner services. NR, not reported; GC, gonorrhea/gonococcal; PKP, previously known positive.

TABLE 2.

Potential Direct Medical Costs and Indirect Costs Saved by Technology-based Partner Service Activities Using the CDC's STIC Calculator

Study	STD Cases Prevented	Direct Medical Costs Saved*	Indirect Costs (Lost Productivity) [†]	Total Costs Saved	Period
Vest et al, 2007 ¹⁰	28.5	US \$26,620	US \$18,742	US \$45,362	January 01, 2004, to June 30, 2006
Hightow-Wiedman et al, 2014 ¹¹	26.40	US \$23,968	US \$14,862	US \$38,830	July 01, 2011 to June 30, 2012
Ehlman et al, 2008 ¹²	16.50	US \$14,661	US \$8,134	US \$22,795	January 2007 to June 2008

* Dollar amounts reported in 2016 dollars

[†] Indirect costs refer to loss of productivity in diagnosed patients as a result of illness, disability, and premature death. For more information, see Chesson et al.⁹